

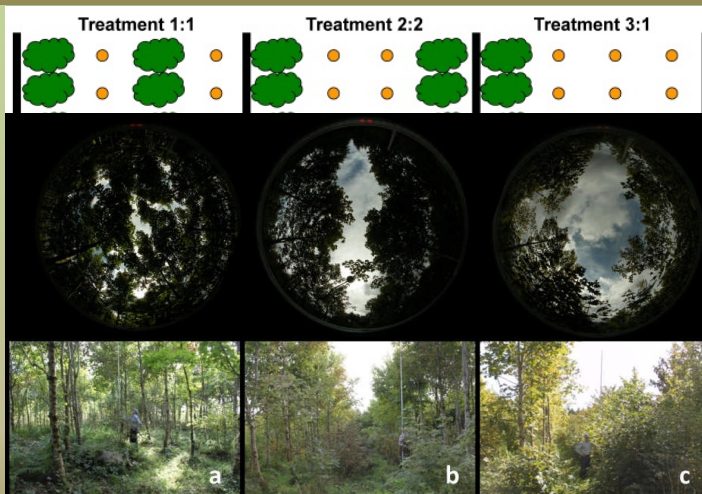
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Introduction

This work forms part of the COFORD funded 5-year Broadleaf Silviculture Research and Development (B-SilvRD) project which comprises 3 strands that seek to improve the quality of broadleaf plantations: Establishment of broadleaves; Thinning of pole-stage broadleaves; Rehabilitation of poorly performing pole-stage broadleaves. The rehabilitation strand aims to address the quality issues of some existing broadleaf plantations through the application of novel treatments and the development of innovative silvicultural solutions. The trials tend to involve more lateral thinking, trial and error, and learning from the (sometimes unexpected) outcomes of treatments. The site of this trial was planted in 1996 with sycamore (*Acer pseudoplatanus*) at 2 m × 2 m spacing (2,500 stems ha⁻¹). Elevation is 125 m and the site was exposed. Soil type is poorly drained acid mineral. A consultancy report in 2009 described the crop as ‘extremely poor’ with relatively extensive areas not having closed canopy and possibly requiring reconstitution via underplanting. Top height was 6 m – Yield Class 4. Speculation of the causes for poor performance included: exposure, inappropriate species/provenance choice, mineral soil rooting depth limited to around 30 cm and lack of early maintenance. Three line thinning treatments were carried out in February 2011 to (Figure 1): remove 50 % canopy cover by removing alternate lines (Treatment 1:1); remove 50 % canopy cover by removing 2:2 lines (Treatment 2:2); and remove 75 % canopy cover by removing 3:1 lines (Treatment 3:1). The trial is designed as a pilot demonstration trial rather than a fully replicated research trial. However, the trial is providing indications of areas for further research. Each research measurement plot consists of one 4-line bay and has at least one similarly treated bay either side of it to act as a buffer between neighbouring treatments.

Materials and Methods

After 3 growing seasons it was visually apparent that there were differences in the coppice regrowth between the 3 treatments. To quantify this all the coppice stools within each treatment plot were measured in September 2013, at the end of the 3rd growing season since felling. To investigate the light available to the coppice five hemispherical photos were taken per treatment at 1.2 m above ground using a Nikon Coolpix P5100 and Nikon fisheye converter FC-E8 0.21x. Each photo was taken from randomly assigned locations in the mid-line of the treatment. In the 2:2 and 3:1 treatments data from the four coppice stools adjacent to the location were analysed. In the 1:1 treatment data from the 2 coppice stools adjacent to the location were used.



Sycamore coppice understory three growing seasons after maidens were cut to three intensities: a) 1:1; b) 2:2; c) 3:1; Hemispherical photos taken September, three years after cutting maidens and diagrammatic representation of treatments

Plot	Treatment					
	1:1		2:2		3:1	
No. stools in plot	33		29		59	
No. dead stools in plot	4		5		5	
No. live stools in plot	29		24		54	
% of stools that are alive in plot	88		83		92	
Mean no. shoots per live stool in plot	7.4	a	8.6	ab	11.5	b
Mean no. shoots >1m tall per live stool in plot	2.8	a	6.3	b	8.6	b
Mean % shoots > 1m tall per live stool in plot	37	a	74	b	75	b
Mean ht of tallest 2 shoots per stool (cm)	139.1	a	194.8	b	239.1	c
Mean dia of tallest 2 shoots per stool (mm)	13.1	a	20.1	b	22.4	b
Sub-sample						
Gap Fraction (%)	6.95	a	23.12	b	38.05	c
Openness (%)	7.34	a	24.41	b	40.30	c
Leaf Area Index	2.993	a	1.930	b	1.300	c
Diffuse PPFD under canopy (mol m ⁻² d ⁻¹)	0.634	a	2.154	b	3.586	c
Direct PPFD under canopy (mol m ⁻² d ⁻¹)	4.07	a	16.14	b	24.7	c
Total PPFD under canopy (mol m ⁻² d ⁻¹)	4.71	a	18.29	b	28.29	c
Mean % shoots > 1m tall per live stool	37.2	a	67.0	b	71.2	b
Mean ht of tallest 2 shoots per stool (cm)	160.1	a	175.8	a	224.1	b
Mean dia of tallest 2 shoots per stool (mm)	14.8	a	18.11	ab	21.04	b
Note: letters indicate significant differences between the treatments (p < 0.05)						

Results

The 1:1 treatment plot had significantly less coppice shoots per stool than the 3:1 treatment, and a reduced proportion of the shoots were > 1 m tall than the 2:2 and 3:1 treatments. Three years after cutting, the height of the tallest two shoots per stool ranged from 40 cm to 403 cm, the shortest in the 1:1 treatment and the tallest in the 3:1 treatment. The mean height of the tallest two shoots was significantly different for each of the treatments with the tallest being in the 3:1 treatment and the smallest in the 1:1 treatment. The mean diameter of the tallest two shoots of the 1:1 treatment was smaller than for the 2:2 and 3:1 treatments.

Five hemispherical photos were taken per plot and data from the stools adjacent to them were used to calculate means. The two stools adjacent to one photo location in the 1:1 plot were both dead. The gap fraction and openness was significantly different for each treatment with the greatest being in the 3:1 treatment and the least in the 1:1 treatment. Leaf Area Index was significantly different for each of the treatments, the least in the 3:1 treatment and greatest in the 1:1 treatment. The total Photosynthetic Photon Flux Density (PPFD) over the canopy was 42.71 mol m⁻² day⁻¹ during the growing season for each of the treatments. The mean total PPFD under the canopy was significantly (p < 0.05) different for each of the three treatments, with 5.08, 16.84 and 26.31 mol m⁻² day⁻¹ for the 1:1, 2:2 and 3:1 treatments respectively. The amounts of diffuse and direct PPFD incident in the understory were also significantly different between the three treatments.